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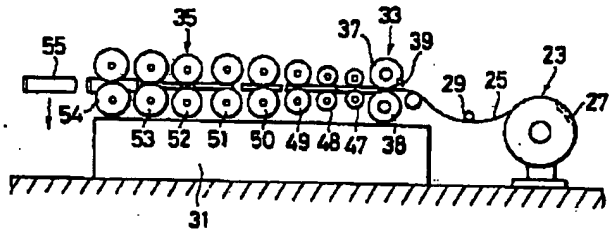
Selected US specifications from IPC sub-class
B21C

(54) **Manufacturing method and manufacturing equipment of tube for heat exchanger**

(57) A feeding device (23) continuously feeds a strip member (25) to a cutting groove forming device (33) which forms cutting grooves at predetermined intervals in the strip member (25). A forming device (35) having a plurality of pairs of forming rolls (47 to 54) forms the strip member (25) already having the cutting grooves into a tube form and applies a tensile force in the direction to open up the cutting grooves (25) to thereby cut the tube into predetermined lengths.

FIG.1



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The drawing(s) originally filed was (were) informal and the print here reproduced is taken from a later filed formal copy.

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FIG.1

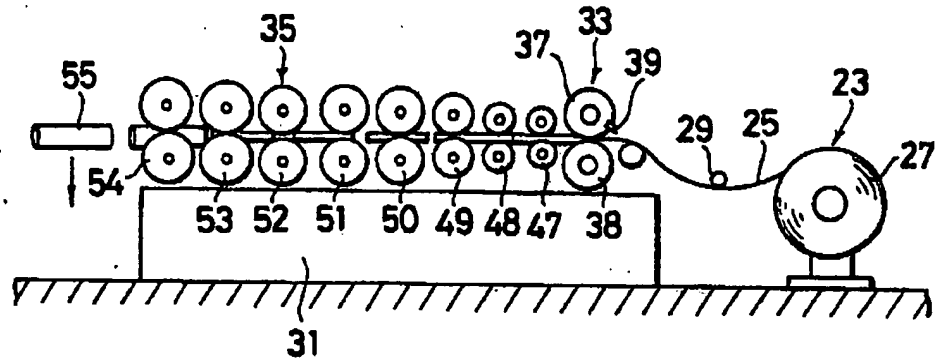


FIG.2

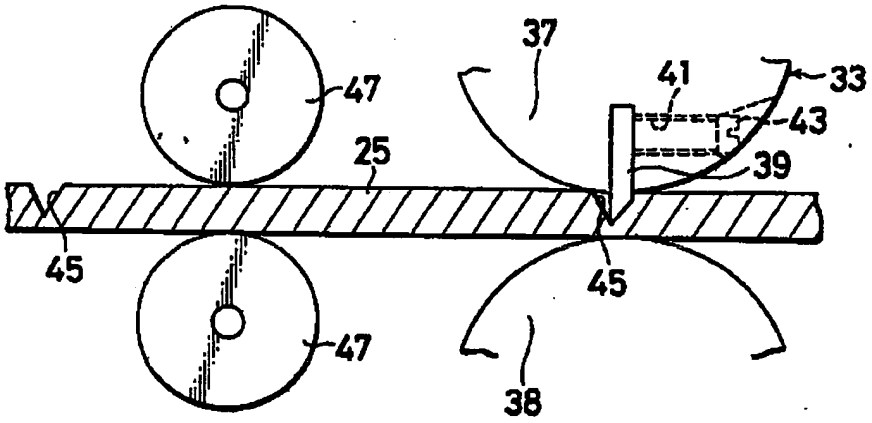


FIG.3

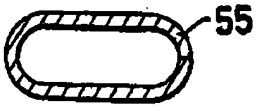
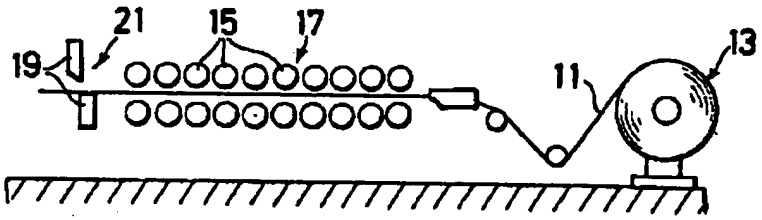


FIG.4



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Manufacturing Method and Manufacturing Equipment of Tube for Heat Exchanger

Detailed Description of the Invention

The present invention relates to a manufacturing method and a manufacturing equipment for manufacturing a tube of a heat exchanger such as a radiator.

In general, a tube for a heat exchanger such as a radiator is manufactured in a way as described in the Laid-Open Patent Application No. 56(1981)-80698.

Fig. 4 shows a conventional manufacturing equipment of a tube for a heat exchanger. This manufacturing equipment of a tube for a heat exchanger consists of a strip member feeding device 13 for feeding a strip member 11 continuously, a forming device 17 provided with plural pairs of forming rolls 15 for forming the strip member 11 which is fed from this strip member feeding device 13 into a tube form, and a cutting device 21 provided with a cutting blade 19 for cutting the strip member 11 formed by this forming device 17 in a predetermined length.

In the thus formed manufacturing equipment of a tube for a heat exchanger, the strip member 11 fed continuously from the strip member feeding device 13 is formed into a tube form while passing through forming rolls 15 of the forming device 17, and cut to a predetermined length by the cutting device 19, thus producing a tube in a predetermined length.

<Problems to Be Solved by the Invention>

In such a conventional manufacturing equipment of a tube for a heat exchanger, however, the strip member 11 is cut after forming the strip member 11 into a tube form. Therefore, in order to cut the strip member 11 to a predetermined length, it is required to detect the speed of the strip member 11 which is fed to the cutting device 21 and to move the cutting blade 19 vertically corresponding to this speed, and when the speed of the strip member 11 gets high, the dimensional accuracy of the cut strip member 11 is lowered.

Also, since it is required to move the cutting blade 19 vertically corresponding to the speed of the strip member 11, the cutting device 21 costs much.

Furthermore, it is required to exchange the cutting blade 19, etc. of the cutting device 21 according

to the shape of the formed tube in such a manufacturing equipment of a tube for a heat exchanger, which requires considerable mandays for preparatory arrangement and so forth.

It is an object of the present invention which has been made to solve abovementioned problems to provide a manufacturing method and a manufacturing equipment of a tube for a heat exchanger that are capable of obtaining a tube having a high dimensional accuracy in the longitudinal direction easily, making the cutting device less expensive, and furthermore, reducing mandays for preparatory arrangement of the cutting device.

In the manufacturing method of a tube for a heat exchanger according to the present invention, cutting grooves are formed in advance at predetermined intervals on a strip member which is fed continuously, thereafter, said strip member is formed into a tube form at a forming portion, and at the time of forming or after forming at said forming portion, said strip member is cut by applying a tensile force in the direction to open the cutting grooves in front and in the rear of said cutting grooves

of said strip member, thereby obtaining a tube in a predetermined length.

Also, a manufacturing equipment of a tube for a heat exchanger comprises a strip member feeding device for feeding a strip member continuously, a cutting groove forming device for forming cutting grooves at predetermined intervals on the strip member which is fed continuously, and a forming device provided with forming rolls which form the strip member with these cutting grooves formed thereon into a tube form and applies a tensile force in the direction to open these cutting grooves in front and in the rear of said cutting grooves of said strip member, thereby to cut said strip member.

In the manufacturing method of a tube for a heat exchanger according to the present invention, cutting grooves are formed in advance at predetermined intervals on a strip member which is fed continuously, thereafter, the strip member is formed into a tube form at a forming portion, and at the time of forming or after forming at the forming portion and a tensile force is applied in the direction to open the cutting grooves in front and in the rear of cutting grooves of the strip member.

With this, the strip member is cut and a tube in a predetermined length is obtainable.

Also, in the manufacturing equipment of a tube for a heat exchanger according to the present invention, cutting grooves are formed in advance at predetermined intervals on a strip member which is fed continuously from a strip member feeding device by means of a cutting groove forming device, thereafter the strip member with cutting grooves formed thereon is formed into a tube form by the forming device, and, at the time of forming or after forming, a tensile force is applied in the direction to open these cutting grooves in front and in the rear of these cutting grooves of the strip member, thereby cutting the strip member into a predetermined shape.

Brief Description of the Drawings

Fig. 1 is a side view showing an embodiment of a manufacturing equipment of a tube for a heat exchanger according to the present invention;

Fig. 2 is a longitudinal sectional view showing the detail in the neighbourhood of the cutting groove forming device shown in Fig. 1;

Fig. 3 is a cross-sectional view showing a formed tube; and

Fig. 4 is a side view showing a conventional manufacturing equipment of a tube for a heat exchanger.

Preferred Embodiments of the Invention

An embodiment of the present invention will be described hereafter referring to the drawings.

Fig. 1 shows an embodiment of a manufacturing equipment of a tube for a heat exchanger according to the present invention. In the Figure, a reference numeral 23 denotes a strip member feeding device for continuously feeding a strip member 25 composed of aluminum.

This strip member feeding device 23 consists of an uncoiler 27 for releasing coiled strip member 25, and a dancer roll 29 for applying a predetermined tension to the strip member 25 which is fed from this uncoiler 27 and removing the deflection thereof.

On the downstream side of this strip member feeding device 23, a cutting groove forming device 33 and a forming device 35 are disposed on the same base 31.

The cutting groove forming device 33 forms

cutting grooves described later at predetermined intervals on the strip member 25 which is fed continuously from the strip member feeding device 23.

This cutting groove forming device 33 consists of a pair of cutting rolls 37, 38 disposed above and below the strip member 25 and a cutting blade 39 fixed on the outer circumference of the upper cutting roll 37.

Fig. 2 shows the detail in the neighbourhood of the cutting groove forming device 33. On the upper cutting roll 37, a concave groove is formed, and the cutting blade 39 is inserted into this concave groove. This cutting blade 39 is fixed to the concave groove by means of an attaching bolt 43 engaged with a bolt hole 41.

The forming device 35 is provided with plural pairs of forming rolls 47 thru 54 that form the strip member 25 having a cutting groove 45 as shown in Fig. 2 formed by the cutting groove forming device 33 into a tube form and apply a tensile force in the direction to open the cutting groove 45 in front and in the rear of the cutting groove 45 of the strip member 25, thereby to cut the strip member 25.

In this embodiment, plural pairs of forming rolls 47 thru 54 are disposed above and below the strip

member 25, and the forming roll has a bigger roll diameter as going downstream.

Besides, the interval between adjacent forming rolls is made shorter than the length of a tube to be manufactured.

In the manufacturing device of a tube for a heat exchanger thus constructed, cutting grooves 45 are formed at predetermined intervals in advance by the cutting groove forming device 33 on the strip member 25 which is fed continuously from the strip member feeding device 23.

In other words, the interval dimension formed by a pair of cutting rolls 37, 38 is made a little smaller than the wall thickness of the strip member 25, and cutting rolls 37, 38 rotate with the movement of the strip member 25. When the cutting blade 39 of the upper cutting roll 37 touches the strip member 25, the cutting groove 45 in a V-shape as shown in Fig. 2 is formed at certain intervals on the strip member 25.

Thereafter, by means of forming rolls 47 thru 54 of the forming device 35, the strip member 25 with the cutting grooves 45 formed thereon is formed step by step, and finally, a tube 55 in a tube form such as shown in Fig. 3 is obtained.

Besides, at the time of forming, a tensile force is applied in the direction to open the cutting grooves in front and in the rear of the cutting grooves 45 of the strip member 25 by means of forming rolls 47 thru 54, thereby to cut the strip member 25 in a predetermined form.

Namely, roll diameters of forming rolls 47 thru 54 are made different in this embodiment. Accordingly, when the cutting groove 45 of the strip member 25 is positioned between a forming roll of a small diameter and a forming roll of a large diameter, a tensile force is applied in front and in the rear of this cutting groove 45 in the direction to open the cutting groove 45, thus the strip member 25 is cut surely at the portion of this cutting groove 45.

Besides, the manufacturing method of a tube for a heat exchanger according to the present invention is executed by using the manufacturing equipment of a tube for a heat exchanger described above.

Namely, in the method according to the present invention, cutting grooves 45 are formed in advance at predetermined intervals on the strip member 25 which is fed continuously, the strip member 25 is formed into a

tube form at the forming portion thereafter, and, at the time of forming or after forming, a tensile force is applied in the direction to open the cutting grooves 45 in front and in the rear of the cutting grooves 45 of the strip member 25. With this, the strip member 25 is cut, thereby to obtain the tube 55 in a predetermined length.

In the manufacturing method and the manufacturing equipment as described above, the cutting blade 39 is attached on the outer circumference of the cutting roll 37 which rotates along with the movement of the strip member 25. Therefore, it is no longer required to detect the speed of the strip member 11 which is fed to the cutting device 21 and to move the cutting blade 19 vertically corresponding to this speed as in the past. As the result, even if the speed of the strip member 11 becomes high, it is possible to secure sufficient dimensional accuracy of the cut strip member 11.

Since it is neither required to move the cutting blade vertically according to the speed of the strip member, it is also possible to provide the cutting device at an inexpensive price.

Furthermore, in the manufacturing equipment of a tube for a heat exchanger according to the present

invention, it is not required to exchange the cutting blade 39 and so forth of the cutting groove forming method 33 even if the shape of the tube 55 to be formed is deformed when the length of the tube 55 is the same. Accordingly, it is possible to reduce the time for preparatory arrangement.

Besides, in the embodiment described above, an example where cutting of the strip member is performed at the time of forming by forming rolls has been described. However, the present invention is not limited to such an embodiment, but it is needless to say that cutting may be performed by applying a tensile force in front and in the rear of the cutting grooves 45 of the strip member 25 by appropriate means after forming the tube 55 with forming rolls.

As described above, according to the manufacturing method and the manufacturing equipment of the present invention, cutting grooves are formed in advance at predetermined intervals on a strip member which is fed continuously, thereafter, the strip member is formed into a tube form at a forming portion, and at the time of forming or after forming at the forming portion, the strip member is cut by applying a tensile force in the

direction to open the cutting grooves in front and in the rear of the cutting grooves of the strip member, thereby obtaining a tube in a predetermined length. Accordingly, a tube of a high lengthwise dimensional accuracy is easily obtainable, and the cutting device may be made less expensive. Furthermore, the mandays for preparatory arrangement for the cutting device may be reduced.

CLAIMS

1. A manufacturing method of a tube for a heat exchanger characterized in that:

cutting grooves are formed in advance at predetermined intervals on a strip member which is fed continuously;

thereafter, said strip member is formed into a tube form at a forming portion; and

at the time of forming or after forming at said forming portion, said strip member is cut by applying a tensile force in the direction to open the cutting grooves in front and in the rear of said cutting grooves of said strip member, thereby obtaining a tube in a predetermined length.

2. A manufacturing method of a tube for a heat exchanger according to claim 1, wherein the strip member is composed of aluminum.

3. A manufacturing method of a tube for a heat exchanger according to claim 1 or claim 2, wherein cutting grooves have a V-shape.

4. A manufacturing equipment of a tube for a heat exchanger comprising:

a strip member feeding device for feeding a strip member continuously;

a cutting groove forming device for forming cutting grooves at predetermined intervals on the strip member which is fed continuously; and

a forming device provided with forming rolls which form the strip member with these cutting grooves formed thereon into a tube form and applies a tensile force in the direction to open these cutting grooves in front and in the rear of said cutting grooves of said strip member, thereby to cut said strip member.

5. A manufacturing equipment of a tube for a heat exchanger according to claim 4, wherein the cutting groove forming device consists of a pair of cutting rolls disposed on both sides of the strip member and a cutting blade fixed to the outer circumference of either one of these cutting rolls.

6. A manufacturing equipment of a tube for a heat exchanger according to claim 4 or claim 5, wherein the strip member is composed of aluminum.

7. A manufacturing equipment of a tube for a heat exchanger according to any one of claim 4 thru claim 6, wherein the cutting grooves have a V-shape.

8. A manufacturing method of a tube for a heat exchanger substantially as hereinbefore described with reference to Figures 1 to 3 of the accompanying drawings.

9. A manufacturing equipment of a tube for a heat exchanger substantially as hereinbefore described with reference to Figures 1 to 3 of the accompanying drawings.

10. A tube for a heat exchanger manufactured by a method according to any of claims 1, 2, 3 and 8 or by equipment according to any of claims 4, 5, 6, 7 or 9.

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